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FEASIBILITY EVALUATION OF ALTERNATIVE ROUTES FOR THE MILLENNIUM PIPELINE PROJECT

October 2002

O'BRIEN & GERE
ENGINEERS, INC.

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Executive summary

O'Brien & Gere Engineers, Inc. ("O'Brien & Gere") performed an evaluation of aspects of the Millennium Pipeline Company, LP ("Millennium") proposal to construct a natural gas pipeline. The purpose of this evaluation was two-fold:

To review the conclusions made by Millennium and the Federal Energy Regulatory Commission ("FERC") regarding technical feasibility and construction options related to Millennium's proposal to construct a 24-inch diameter gas pipeline through portions of Rockland and Westchester counties.

- To identify and perform a screening level evaluation of alternate routes that avoid significant coastal zone and other environmental impacts associated with Millennium's Proposed Route, as described in the Final Environmental Impact Statement (FEIS), including impacts on the Croton-on-Hudson Well Field and water supply, and the Jane E. Lytle Memorial Arboretum.

In evaluating a proposal which may have impacts to the environment, the accepted hierarchical review process for environmental proposals is the consideration of: (a) measures that avoid significant impacts to critical environmental resources, followed by (b) measures that reduce, minimize and mitigate significant impacts.

The Millennium proposal significantly impacts at least three significant coastal zone resources:

- Haverstraw Bay, an ecologically sensitive portion of the Hudson River. Haverstraw Bay, the Croton River and Croton Bay have been designated as Significant Coastal Fish and Wildlife Habitats. Despite this designation, the Millennium project proposal has not included measures to avoid this area, or to reduce impacts to the extent reasonably available.
- The Village of Croton-on-Hudson's public water supply well field is being traversed by the proposed pipeline route. This well field is the sole source of water for 3500 area residents. The selection by Millennium and approval by FERC of a route that traverses this well field endangers this water supply. No measures have been taken or suggested by the sponsor to avoid or mitigate the risks to the well field, and no measures have been taken to ensure the integrity of the water supply should it be interrupted by the construction or operation of the pipeline. Damage to the well field would result in the loss of the water supply, infliction of hardship on local residents and businesses, the cost of an interim water supply, and the cost to the Village residents in the millions of dollars for a replacement water supply.
- A portion of the Jane E. Lytle Memorial Arboretum would be crossed by the pipeline route, necessitating the clearing of the right-

of-way and the destruction of the character of a large portion of the Arboretum. The Arboretum is an effective example of wetland habitat because the visitor can be immersed in the ecological setting; the imposition of cleared right-of-way will present an unfavorable counterpoint to the wetland and wood land habitat, and reduce the educational value of the resource. Replacement or mitigation of this loss has not been suggested by Millennium or FERC.

O'Brien & Gere assembled local resource information, including environmental resource maps and other documentation, street maps, recent aerial photography, and other materials to evaluate potential routing alternatives that achieve the objective of either avoiding, minimizing or mitigating impacts to the above environmental coastal resources. These alternatives were not evaluated in the Draft, Supplemental Draft, or Final Environmental Impact Statement (DEIS, SDEIS and FEIS, respectively. They include:

- alternate Hudson River crossing locations that avoid Haverstraw Bay and the impacts of the present crossing route
- alternate river crossing technologies that would avoid or minimize the impacts to the ecology of the Hudson River and Haverstraw Bay
- alternate route segments on the east side of the Hudson River that would avoid the Village well field and the Arboretum
- alternate routes on the west side of the river, combined with an alternate river crossing location, that avoids the three critical coastal zone resources and the impacts of the present project proposal.

Briefly, the alternatives that were developed and evaluated are as follows; the accompanying report presents a more detailed analysis of the respective alternatives:

Palisades/Dobbs Ferry Alternative 1 – This route proceeds further south on the west bank of the Hudson River than Millennium's Proposed Route to a point opposite Dobbs Ferry, where it would cross the river. On the east bank of the Hudson River it would reconnect with the presently approved route northeast of the Ardsley Country Club. This route avoids Haverstraw Bay, the Village well field and the Arboretum; involves a shorter Hudson River crossing, about 4250 feet less than the Proposed Route, and does not substitute other significant environmental impacts for those that it avoids. It also is estimated to cost approximately $10 million less than the stretch of the proposed route between the two interconnection points.

Palisades/Dobbs Ferry Alternative 2 – This route follows a slightly different path down the west bank of the Hudson River, paralleling a Penn Central railroad right-of-way, to the same crossing point opposite Dobbs Ferry. This stretch is about 18.5 miles in length or 2.1 miles longer than the preceding option, but still 12 miles shorter than the approved option. The construction cost, would be equivalent to the

approved alternative, except that this route avoids Haverstraw Bay, the Village well field and the Arboretum, and the impacts of the proposed route to these resources. Again, this alternative does not substitute other significant environmental impacts for those that it avoids.

Hudson River South "Clarkstown/Route 117" Alternative – This route is a modified version of a route that was identified by the Village of Croton-on-Hudson in its comments to FERC but was never evaluated in the FEIS. On the west bank of the Hudson River, this alternative places the pipeline along a previously unevaluated route through Clarkstown to the Nyack Beach State Park, crossing the Hudson River and landing at the Rockwood Hall State Park. From there, it would follow the alternative route proposed by the members of NUMB, which is referred to as the "Route 117 Alignment" in the FEIS. This route is more doable than the similar alternative evaluating the FEIS because it avoids the long shoreline construction on the west side of the River. This route avoids Haverstraw Bay, the Village of Croton-on-Hudson Well field and the Jane E. Lytle Memorial Arboretum. This route also avoids Memorial Park and the streets in the Village of Nyack so that it doesn't substitute impacts in the Village of Croton-on-Hudson for impacts at these locations. It is 10.7 miles shorter than the route proposed by Millennium and approved by FERC, and is estimated to cost about $10 million less than the approved route. Here also, this alternative does not substitute other significant environmental impacts for those that it avoids.

Hudson River North – Alternatives 1 and 2 – These alternatives were developed by Millennium to avoid crossing the Hudson River through Haverstraw Bay, but were then dismissed from further consideration in favor of a Haverstraw Bay crossing. O'Brien & Gere considered it important to re-evaluate these options since the Hudson River North Alternatives both avoid the critical coastal zone resources of Haverstaw Bay. In addition, O'Brien & Gere proposes that alternative construction techniques be used to resolve the problems that led to the dismissal of these alternatives in the FEIS. These techniques include directional drilling, and installing the pipe using short sections installed similar to the way a water pipeline is installed. These routes proceed north to cross the Hudson River at points north of Haverstraw Bay. Costs for construction of these alternatives would be higher than the equivalent stretches in Millennium's proposal, but their implementation would result in the avoidance of Haverstraw Bay and the resultant impacts to its ecological resources.

Navigation Channel Alternative – This option involves a crossing of a portion of the Hudson River in the vicinity of Bowline Point to the navigation channel in the River. The pipeline would then be installed in the navigation channel south to where the Hudson River South "Clarkstown/Route 117" Alternative traverses the river, then proceeds to the eastern shore. The cost of this route segment would be about $86 million as compared to $50.9 million of the equivalent stretch of the approved route. This route would avoid Haverstraw Bay, the Village of Croton-on-Hudson Well field and the Arboretum and the impacts of the present route to these alternatives.

See Figure 1 for a map of Millennium's Proposed Route and the alternative alignments described above.

Directional drill of Haverstraw Bay - A directional drilled crossing of Haverstraw Bay would involve drilling a small diameter pilot hole underneath the Bay and then enlarging the pilot hole until the hole is large enough to accommodate the 24-inch diameter pipe. This technique requires a staging area on both banks of the Bay. Normally approximately one acre is required on one bank and an area approximately 50 feet wide and the length of the crossing is required on the opposite bank.

Millennium concluded that a directional drilled crossing of Haverstraw Bay is not feasible due to the following:

The proposed crossing would be 2.1 miles long, making directional drilling infeasible as a construction option.

- There is not adequate room on either side of Haverstraw Bay to string a 2.1 mile long section of 24-inch steel pipe.

O'Brien & Gere's investigation of the use of the directional drilled technique included consultation with Cherrington Corporation of Sacramento, California, an experienced directional drilling contractor and a recognized expert in the industry, and with Mueser Rutledge Consulting Engineers, Inc. of New York City which has extensive experience with subsurface exploration and who are presently providing geotechnical consulting on the proposed Tappan Zee Bridge crossing for the New York State Thruway Authority.

Cherrington Corporation recognized that a project of this magnitude is completely outside the realm of conventional HDD technology as used today. However, with specific enhancements to the conventional HDD technology 11,000' is achievable although the environmental ramifications with fracture potentials exists. The technological advancements with the EBB System make HDD crossings 11,000 and beyond achievable and more importantly, these technology advancements also negate the environmental ramification, by design.

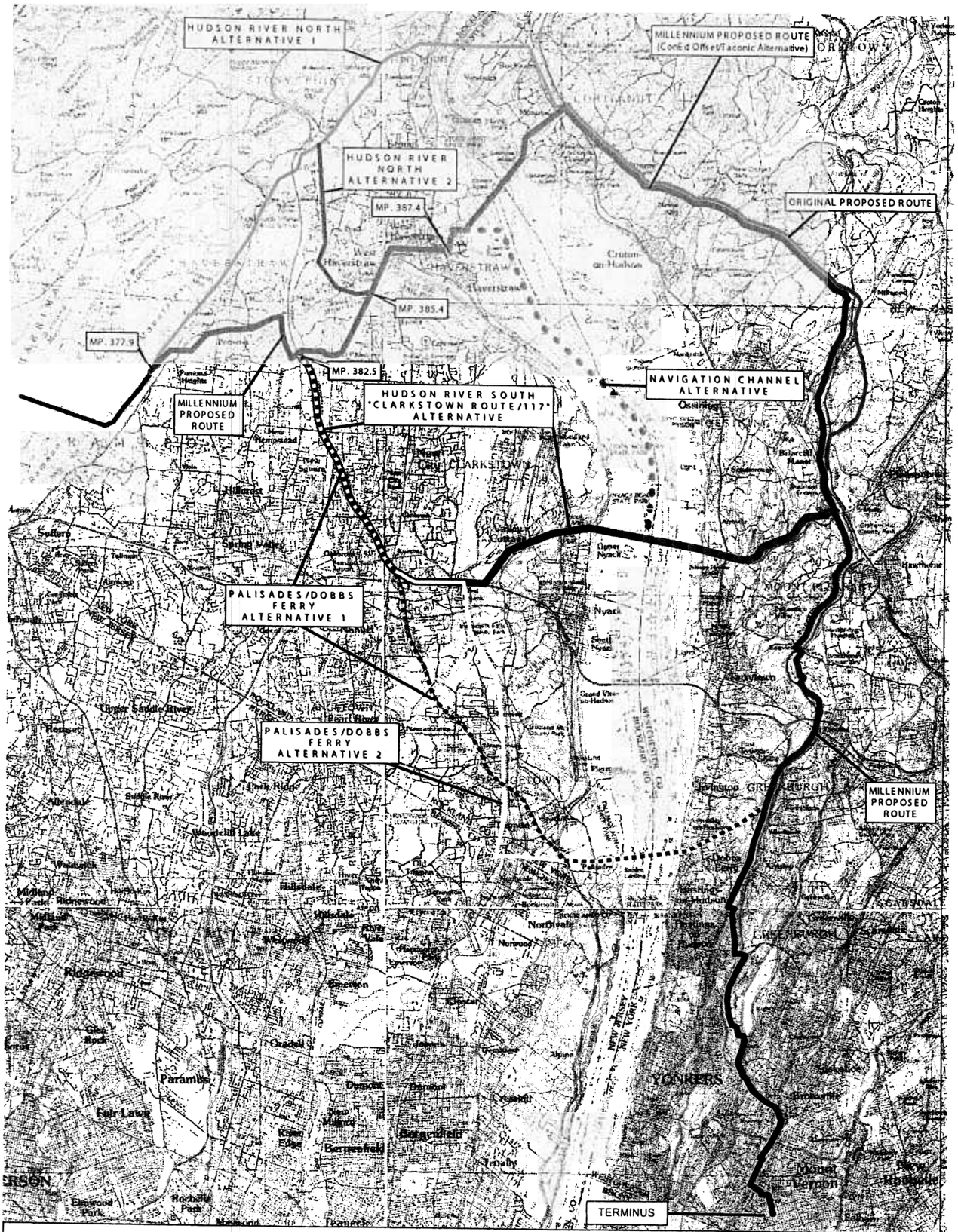
Cherrington also concluded that with the improvements in equipment, it would be possible to assemble the 24-inch pipe in 1000-foot sections as it is being pulled across the River. Therefore, there is ample room on the east side of Haverstraw Bay, in the VA Hospital Grounds, to permit the staging for the implementation a directional drilled method. A final decision to use the directional drill method can only be made after a detailed evaluation of the site.

The cost for directional drilling ranges from 2 to 2.5 times that of an open cut, lay barge method, which in the case of Haverstraw Bay could be 12 to 15 million dollars in additional cost over the lay barge method. The benefit would be the avoidance of sensitive ecological resources in the Bay.

O'Brien & Gere concluded that the evaluation performed herein presents pipeline routing alternatives that:

Are technically feasible
2. Are reasonable in their constructability
3. Generally reduce the length of the Hudson River crossing, resulting in a net cost savings to the project
4 Generally reduce the length of the upland route, resulting in a net cost savings to the project
5 Provide cost-effective alternatives to the Millennium proposal
6 Avoid critical coastal zone resources, including Haverstraw Bay, the Village water supply well field, and the Arboretum, on the east shore of the Hudson River, without substituting equivalent impacts elsewhere.

The concept embodied in Number 6, preceding, is that this evaluation presents viable, cost-effective alternatives to Millennium's proposal that do not substitute significant environmental impacts at a new location as the price for avoiding impacts to the critical coastal zone resources of Haverstraw Bay, the Village of Croton-on-Hudson water supply well field, and the Arboretum. In general, routing alternatives presented herein present a net reduction in significant environmental impacts combined with a construction cost savings to the project sponsor. As such, implementation of an appropriate alternative as presented in this evaluation will result in a favorable outcome to the environmental resources of the coastal zone and to the project sponsor.


HUDSON RIVER NORTH ALTERNATIVE 1
MILLENNIUM PROPOSED ROUTE (ConEd Offset/Taconic Alternative)
HUDSON RIVER NORTH ALTERNATIVE 2
MP. 387.4
ORIGINAL PROPOSED ROUTE
MP. 385.4
MP. 377.9
MP. 382.5
NAVIGATION CHANNEL ALTERNATIVE
MILLENNIUM PROPOSED ROUTE
HUDSON RIVER SOUTH "CLARKSTOWN ROUTE/117" ALTERNATIVE
PALISADES/DOBBS FERRY ALTERNATIVE 1
PALISADES/DOBBS FERRY ALTERNATIVE 2
MILLENNIUM PROPOSED ROUTE
TERMINUS
ALIGNMENTS
HUDSON RIVER NORTH ALTERNATIVE 1 (MILLENNIUM)
HUDSON RIVER NORTH ALTERNATIVE 2 (MILLENNIUM)
HUDSON RIVER SOUTH "CLARKSTOWN ROUTE/117" ALTERNATIVE
MILLENNIUM PROPOSED ROUTE (ORIGINAL)
MILLENNIUM PROPOSED ROUTE/(ConEd OFFSET/TACONIC STATE PARKWAY SECTION)
NAVIGATION CHANNEL ALTERNATIVE
PALISADES/DOBBS FERRY ALTERNATIVE 1
PALISADES/DOBBS FERRY ALTERNATIVE 2
MILLENNIUM PROPOSED ROUTE AND ALTERNATIVE ALIGNMENTS
0
6 Miles
FIGURE 1
FILE NO: 4716.31532
DATE: OCTOBER 2002
O'BRIEN & GERE

1. Introduction

1.1. Purpose

The purpose of this evaluation is two-fold:

- To review the conclusions made by Millennium Pipeline Company, LP., (Millennium) and the Federal Energy Regulatory Commission (FERC) regarding technical feasibility and construction options related to Millennium's proposal to construct a 24-inch diameter gas pipeline through portions of Rockland and Westchester counties (the "Proposed Route").

- To identify and perform a screening level evaluation of alternate routes that avoid significant coastal and environmental impacts associated with Millennium's Proposed Route, as described in the Final Environmental Impact Statement (FEIS), including impacts on the Croton-on-Hudson Well Field and water supply, and the Jane E. Lytle Memorial Arboretum.

As part of this evaluation, O'Brien & Gere considered the following elements:

(a) With respect to its technical components, is the proposal technically feasible?

(b) With respect to its environmental impacts, does it adequately avoid environmental impacts?

(c) If significant environmental impacts can not be avoided, can the impacts be mitigated, either by modifying the project or taking additional, mitigative measures?

This report presents O'Brien & Gere's findings and conclusions regarding alternatives to the route proposed by Millennium, which, in O'Brien & Gere's opinion, are technically feasible and avoid the significant coastal and environmental impacts associated with the Millennium proposal.

1.2. Scope

O'Brien & Gere's scope for reviewing Millennium's Proposed Route and the alternative routes consisted of the following tasks:

- Review of the FEIS and related data – this information establishes the route selected by Millennium and the baseline impacts that implementation of this proposal will cause to critical environmental impacts.
  Review of USGS planimetric and topographic mapping of the study area – these materials were a source of environmental resource and potential pipeline route information.
- Review recent aerial mapping – these materials were a source of environmental resource and potential pipeline route information.
  Review geotechnical data for several locations along the Hudson River - these materials were a source of environmental resource and potential pipeline route information, particularly with respect to the evaluation of options for a Hudson River crossing.
- Partial field review of proposed route – a field evaluation of potential alternate pipeline routes was performed based on an initial desktop assessment.
- Partial field review of alternative routes proposed by Millennium to assess technical and environmental constraints.
  Discussion of project issues with geotechnical consultants (Mueser Rutledge) to provide an understanding of local and regional geotechnical issues.
- Discussion of directional drilling issues with Cherrington Corporation, an experienced directional drilling contractor.
- Securing existing mapping in order to select potential routes that would use existing rights-of-way while avoiding environmental resources.
- Field review of potential routes to confirm desktop information.
- Identify types of areas impacted by construction to ascertain whether critical resources have the potential to be impacted.
  Preparing a qualitative cost estimate of the new option as compared to Millennium's proposal.
  Locating a feasible location for crossing the Hudson River, including consideration of appropriate staging areas.
- Describing the routes so that they can be independently validated.

Environmental information regarding streams, wetlands, land use, historic sites, topography, rock outcrops, wells, and ground water zones was obtained from the Rockland County Department of Planning (RCDP) and the Westchester County Department of Planning (WCDP) and reviewed by O'Brien & Gere to assess general environmental conditions along the three alternative pipeline routes identified by O'Brien & Gere. The year 2000 aerial photographs for the three alternative routes were also obtained and reviewed. Finally, a site visit was performed by an O'Brien & Gere scientist to observe general environmental field conditions along the three alternative routes.

1.3. Background

In 1997, Millennium filed its initial application to the Federal Energy Regulatory Commission (FERC) to construct and operate a natural gas pipeline that would extend from Lake Erie across New York to Mount Vernon in Westchester County, New York. In April 1999 a draft environmental impact statement (DEIS) was issued by FERC, followed by a supplemental draft environmental impact statement (SDEIS) on March 12, 2001. The final environmental impact statement (FEIS) issued in October 2001 identifies FERC's preferred alternative route, which is described in Section 2 of this report. FERC conditionally approved this route in its Interim Order, dated December 19, 2001, and Final Order, dated September 19, 2002.

On May 9, 2002, the New York State Department of State (NYSDOS) issued an objection to the Proposed Route pursuant to the Coastal Zone Management Act (CZMA), because the route severely impacts the protected coastal resources, including Haverstraw Bay in the Hudson River, the Village of Croton-on-Hudson Well Field, and the Jane E. Lytle Memorial Arboretum. Millennium has appealed this decision to the U.S. Department of Commerce and the proceeding is ongoing as of the date of this report.

2. Proposed route

The current Proposed Route for eastern Rockland County, utilizes existing gas mains from mile point 377.9 in Ramapo to the Bowline Power Plant in Haverstraw.

The pipeline would cross the Hudson River at mile point 387.5 in Haverstraw Bay between Bowline Point, on the west shoreline, and the Franklin Delano Roosevelt Veterans Administration (VA) Hospital, located in Cortlandt on the east shoreline. The River crossing would be 2.1 miles long and is described in detail in paragraphs 5 and 6 of this section.

From the VA Hospital, the pipe would proceed east approximately 8500' (1.6 miles) to an existing Con Edison (ConEd) electrical transmission corridor that runs northwest to southeast through the upper section of Westchester County. As currently proposed, the pipeline would be installed along the southwest side of the ConEd right-of-way at an offset of 100 feet from the nearest electrical conductor. The pipeline would follow this route for approximately 7.6 miles until it intersects with the Taconic State Parkway, a six-lane expressway. At this point, the pipeline would turn southwest and follow the west side of the Taconic State Parkway and North County Trail for 5.7 miles. The 13.3-mile pipeline section through Westchester County (mile point 391.9 to 404.5), as described above, has been identified by Millennium as the ConEd Offset/Taconic Parkway Alternative and has been filed in the FEIS.

From mile point 404.5 to 421.8, the pipeline follows a southerly direction using a variety of right-of-ways to reach its terminus in Mount Vernon, New York. The total upland length of the Proposed Route along the east side of the Hudson is 32.2 miles. Along this 32.2 mile section, the proposed pipeline encroaches upon the Jane E. Lytle Memorial Arboretum at mile point 394.5 and will be within the Village of Croton-on-Hudson Well fields at mile point 395.7, as shown on aerial maps submitted by Millennium to FERC in its Initial Brief. These two environmental issues, among others, will be discussed in further detail from paragraph 7 onwards.

FERC has approved a crossing of Haverstraw Bay using an "Open-Cut Lay-Barge" method. This construction technique involves the continuous excavation of the trench using a single dredge unit with a closed bucket. Other equipment that will be required include a lay barge, a pipe supply barge, a crane dredge, and bottom dump barges. A construction work area 1,300 feet in length by 100-150 feet in width is necessary to accommodate the equipment, allow for pipe installation and for storage of backfill material.

The process of pipe laying is done in a sequential order and begins with dredging of bottom sediments to a maximum trench depth of 20 feet. All dredged materials would be stored on barges and later used as backfill.

Sections of pipe approximately 40 feet long would then be moved to the lay barge, welded together, then lowered into the Hudson River as the barge is moved forward. Millennium anticipates that it would take about 2 weeks to complete work in each 1,300-foot segment assuming a 10-hour workday (p.5-58, FEIS – Volume 1). Millennium and appropriate regulatory agencies have agreed upon a construction window of 2 ½ months (September 1 – November 15) to complete the crossing.

Haverstraw Bay Impacts

Haverstraw Bay has been designated a Significant Coastal Fish and Wildlife Habitat under the Coastal Management Zone Act. In addition to this designation, Haverstraw Bay is also an Essential Fish Habitat (EFH) and a significant habitat complex within New York Bight Watershed. This portion of the Hudson River is ranked among the most productive systems on the northern Atlantic coast for fisheries (Atlas, 1977). This productive estuary area is a regionally significant nursery and wintering habitat for a number of anadromous, estuarine and marine fish species, and is a migratory and feeding area for birds and fish that feed on the abundant fish and benthic invertebrate resources in the area. The extensive submerged vegetative beds in Haverstraw Bay provide much of the vital habitat offered by the lower Hudson River.

The National Marine Fisheries Service (NMFS) has identified Haverstraw Bay as an EFH for seven species of fish that inhabit the Hudson River in this area. Congress defined EFH as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (Magnuson-Stevens Act 16 U.S.C. 1801 *et sec*; Act). Additionally, Congress asserted in the Act: "*one of the greatest long-term threats to the viability of commercial and recreational fisheries is the continuing loss of marine, estuarine and other aquatic habitats. Habitat considerations should receive increased attention for the conservation and management of fishery resources of the U.S.*" Therefore, the designation of Haverstraw Bay as an EFH is a clear indication of the area's importance to the fishery of the Hudson River and the fishery of the northeastern coast.

Habitat disturbance by human activities such as dredging and in-river and shoreline construction results in impaired water quality that has some impact on many species – not only those identified as part of the EFH designation, but also migrating species using the Hudson River. FERC concludes that the project's impacts will be "minimal" to the EFH. However, it is certain that the project would have an adverse effect on the EFH and the aquatic species and physical characteristics of portions of Haverstraw Bay. NMFS recognizes adverse effects as "any impact which reduces the quality and/or quantity of the EFH." Adverse effects may include direct (*i.e.*, contamination or physical disruption), indirect (*i.e.*, loss of prey, reduction in species fecundity), and site-specific or habitat-wide impacts (*i.e.*, individual, cumulative, or synergistic consequences of actions). The designation recognizes that impacts occur to the ecosystem, and that these impacts can not be evaluated by focussing on individual species, but rather the myriad of interactions, which occur in the ecosystem.

The Palisades Dobbs Ferry Alternative 1 and Palisades Dobbs Ferry Alternative 2 proposed alignments, which are discussed in detail in later sections of this report, propose a crossing of the Hudson River at a potentially "less environmentally sensitive" area of the Hudson River. Both of these alternatives propose a crossing at a location just south of the Tallman Mountain State Park at the current location of an existing Tennessee pipeline river crossing. The area of this crossing is at the southern end of another NYSDOS Significant Habitat known as Piermont Marsh. However, the length of these proposed alternative crossings of the Piermont Marsh Significant Habitat is only approximately 2000 feet as compared to the 2.1-mile crossing of the Haverstraw Bay Significant Habitat with the currently approved route. In either case, methods are available to construct across these significant habitats, *i.e.* directional drill, which could reduce impacts to these resources.

While any crossing of the Hudson River will invariably result in some impacts, other feasible crossing locations that are less environmentally sensitive than the Haverstraw Bay crossing are provided in the following sections of this report. In addition, none of the alternatives evaluated herein addressing other Hudson River crossing locations is designated a Significant Fish and Wildlife Habitat, a designation indicating a sensitive coastal zone resource.

Village of Croton-on-Hudson Well Field Impacts

The Proposed Route, as approved, will also traverse through the eastern and northern portions of the Village of Croton-on-Hudson Well Field property and coming within close proximity (less than 40 feet) of a Town well. There are five types of impacts to the Well Field that can occur. Any of these can result in an impairment of either the yield or quality of the resource, and neither Millennium nor FERC has offered a contingency option in the event that the Village's drinking water supply is lost, with a replacement cost in the millions of dollars. These impacts can be categorized as:

- Construction Impacts – Dewatering
- Construction Impacts – Contaminant Releases and Aquifer Impairment
- Construction Impacts – Blasting
- Reduction in Well Field Expansion Options
- Pipeline Operational Impacts

Construction Impacts – Dewatering

Adverse effects from pipeline construction through this resource are potentially substantial. Trench dewatering is proposed by Millennium during pipeline construction in areas of shallow ground water. Based upon hydrogeologic studies of the Village well field, ground water is known to be very shallow in the well field area. Trench construction activities can be expected to encounter the ground water table. These aquifer studies have also documented that the soils that comprise the Village well field aquifer are of high permeability (Geraghty & Miller, 1988, 1989, 1992; Reynolds, 1988). Dewatering the trench in the

Village well field area could require the pumping of significant volumes of ground water. The pumping of high volumes of ground water during dewatering could cause a decline in the ground water table at the Village supply wells. Such a decline in the ground water table could reduce the production capacity of the supply wells.

The pumping of large volumes of ground water during dewatering activities could also deplete the aquifer's storage capacity of ground water unless the pumped water is directly recharged to the aquifer. This storage depletion could be especially critical during dry months when surface water flow in the Croton River is low. Geraghty & Miller, (1988) estimated that during dry conditions, when there is no flow in the Croton River, the aquifer storage would limit normal well field production to 41 days. Dewatering activities to construct the pipeline that occurred during such dry periods could significantly reduce the available water for the Village. Typically, dry periods, such as summer months, are also times of higher water demand, thus making it even more critical that the aquifer storage not be reduced by dewatering.

The pumping of large volumes of ground water during dewatering activities could also reduce the shallow aquifer recharge of the Village well field. This reduction of the shallow aquifer recharge could be especially critical during dry months when surface water flow in the Croton River is low.

Construction Impacts – Contaminant Releases and Aquifer Impairment

Spills or leaks resulting in the losses of contaminants during construction and operation of the pipeline can occur during maintenance, fueling, or equipment failure. Losses could also occur through the use of methanol for the hydrostatic testing of the pipeline. The potential impact of contaminant losses during construction is significant in the Village's well field area because of the short time necessary for contaminants to migrate from the construction site to the supply wells. The Village well field aquifer studies have documented that the aquifer soils in the Village well field are very permeable. The surface soils in the Village well field are also very permeable. The ground water table is shallow and is expected to be exposed in the trench during construction. Finally the close proximity of the supply wells to the pipeline would result in rapid migration of contaminants, introduced during construction, from the construction site to the supply wells. Given these site conditions, losses of contaminants would be expected to migrate to the ground water table almost instantaneously. Furthermore, once the contaminants reach the ground water table, they would immediately begin to migrate to the supply wells. Clean up of accidental losses would not be a viable option in the well field because of the rapid migration. Contamination of an aquifer cannot be readily remediated and could result in a long-term impact to the aquifer. There are numerous sites across New York and the country where well fields have been contaminated and remediation is requiring years to complete.

Examples of locations in New York State where there have been long-term impacts to aquifers include:

Olean well field (NYS Superfund and NPL Site) – Volatile organic contaminants impacted an alluvial aquifer. Ground water remediation was initiated in 1989 and is ongoing.

- Brewster well field (NPL Site) – Volatile organic compounds contaminated a public well field. Remediation initiated in 1986 and is ongoing.
- Endicott Village well field (NPL Site) – Alluvial aquifer contaminated by volatile organic contaminant. Remediation initiated in 1984 and was operated until 1995.
- Vestal Water Supply Wells 11 & 42 (NPL Site) – Volatile organic contaminants in an alluvial aquifer. Remediation initiated in 1988 and is ongoing.

Construction Impacts – Blasting

Millennium has indicated to FERC that it does not anticipate that any blasting will be performed in close proximity to the Village well field based upon the geologic logs from wells in the well field. However, Millennium states that it does not know the depth to bedrock in the area of the proposed pipeline in the vicinity of the Village well field. Bedrock is present at the ground surface along the perimeter of the well field. Blasting in the immediate vicinity of the well field could affect the water quality and efficiency of the supply wells through changes to surface and subsurface modifications resulting from blasting operations. The blasting could also cause impacts to the physical structures at the well field.

Reduction in Well Field Expansion Options

The potential future expansion of the Village well field by the reactivation of two currently unused wells or the installation of new wells has been noted by the Village. The presence of the pipeline within the Village well field would reduce the available area the Village has for well field expansion because of restrictions on drilling in the immediate vicinity of the pipeline. The limits placed on future expansion of the well field may result in impacts to the ability of the Village to meet future water supply needs through the use of its well field.

The hydrogeologic studies of the Village well field have documented that there is a hydraulic connection between the aquifer and the Croton River (Geraghty & Miller, 1989, 1992). Construction activities in the river can affect the hydraulic properties of the river bottom such as compaction of the river bottom materials that could reduce the hydraulic connection between the aquifer and the river.

Pipeline Operational Impacts

During pipeline operation, the continued presence of the pipeline in the Village well field will present a risk to the quality of the Village's water supply. A pipeline leak would introduce contaminants into the ground water. Natural gas can dissolve in and be transported by ground water. The concentration of the dissolved gases will depend upon the physical

and chemical conditions of the ground water. A pipeline leak could not only introduce natural gas but also the artificial odor used as a leak warning sensor into the ground water and adversely impact the quality of the ground water. In addition, hydrocarbon condensates are known to form in gas pipelines. These condensates will cause ground water contamination if a leak in the pipeline occurs. Given the high permeability of the Village well field aquifer and the close proximity to the Village supply wells to the pipeline, rapid migration of these contaminants to the supply wells would be expected.

Jane E. Lytle Memorial Arboretum Impacts

The Proposed Route would cross the Jane E. Lytle Memorial Arboretum (the Arboretum) in the Village of Croton-on-Hudson. The Arboretum, a 20.4-acre area located in the northern part of the Village, represents a sensitive habitat offering a unique educational experience in the area. The Village recognizes the damage that previous development has had on wetland resources, and clearly notes educational and scientific opportunities as important beneficial functions of wetlands included in the Arboretum. The proposed route, as approved, will traverse through an approximate 100-foot swath of the northern portion of the Arboretum, including portions of a forested wetland at the property. Adverse effects from pipeline construction through this resource are potentially substantial.

The project will have short-term and long-term impacts to hydrologic conditions from the disruption of hydrologic features at the Arboretum property. The proposed pipeline will cross several intermittent streams and one perennial stream within the Arboretum property. The placement of the trench and access roads across these features will disrupt drainage patterns temporarily and potentially permanently. An excavated trench will act as a conduit or drain and intercept and/or divert surface and ground waters.

The removal of mature forest at the Arboretum property would result in impacts to the current drainage and hydrologic patterns influencing the downstream wetland at the Arboretum. Removal of mature forest can result in changes of water availability to the current downstream wetland systems causing possible impacts to the current state of fauna and flora balance. Removal of mature trees will increase the potential for increased runoff and stream flow. Trees impact local hydrology in several ways: they uptake water, transpire water, intercept rainfall, and reduce overland flow velocities. Removing mature trees take away these hydrologic aspects from an area, which can significantly increase runoff and stream flow, thereby increasing the potential for impacts from increased erosion and changes in downstream hydrologic conditions. This change in hydrologic conditions would have a significant impact on habitats and flora and fauna composition, destroying the habitat and educational values of the wetland.

The removal of mature forests can also impact hydrologic conditions by increasing exposure to sunlight and wind. Exposure to increased sunlight will increase evaporation potential, thereby reducing the

available water to downstream resources and increase water temperatures entering downstream water bodies and/or wetlands. Increased wind exposure will also have an impact on evaporation rates as well as increase the potential for soil erosion. Ultimately, these potential changes to hydrology will significantly impact flora and fauna compositions to the deforested area as well as downstream areas.

Also, impacts from the removal of the mature upland and wetland forest will include a decrease in the available forested habitat as well as degradation of interior forested habitat along the pipeline route in the Arboretum property and other sensitive nearby forested resources including the Brinton Brook Sanctuary. The impact to interior forested habitat from clear cutting may extend 300 feet from the edge of the clear cut, which translates to an impact on interior forest habitat at the Arboretum property of approximately 5 acres, or 25% of the property (Personal Correspondence, 2001a). The impact would likely result, in a change of habitat type from an interior forest habitat to an edge or transition habitat. Edge or transition habitats create the opportunity for different, usually invasive, flora and fauna to become established.

Impacts would occur to stream and wetland resources at the Arboretum property from mechanical and structural failures with the dry stream crossing method identified for this project. The perennial and intermittent stream dry crossing method proposed (the use of the dam and pump method) may not be desirable because of potential pump failure, fuel storage for pumps, and pump refueling operations. Fuel storage and refueling operations are not to occur within 100 feet of wetlands or streams.

As previously noted, the proposed pipeline will traverse through portions of a forested wetland at the Arboretum property. Wetland soil excavation and staging at the Arboretum property would impact downstream waters and wetlands. The soils identified for the wetland at the Arboretum property indicate that it is muck with potential for high water capacity and is highly susceptible to wind erosion (USDA, 1994). Based on this information, impacts from staging these soils near streams and wetlands are more likely if appropriate erosion control methods are not utilized. The amount of moisture or wetness in the soils at the time of construction will likely dictate the appropriate erosion controls to be utilized.

In addition, the disturbance of soils, in both upland and wetland areas would provide an opportunity for invasive species to colonize. Disturbances to an area, such as vegetation removal and excavation or scraping of soils, creates conditions which are favorable for the invasion and establishment of unwanted vegetation, such as *Phragmites australis* (common reed), *Polygonum cuspidatum* (Japanese knotweed), *Lythrum salicartia* (purple loosestrife), and *Lonicera* sp. (honeysuckle).

Also, the Arboretum property is currently utilized by the Village school system as part of its middle school science curriculum. This results in approximately five annual visits to the Arboretum property by students,

teachers, and school administrators (Personal Communication, 2001b). Construction and operation of the proposed pipeline through the Arboretum property would result in a disruption (both long- and short-term) of the established educational curricula.

3. Palisades/Dobbs Ferry Alternative 1

3.1. Route description

This section describes an alternate route known as the "Palisades Dobbs Ferry Alternative 1" (Figure 3.1), a route that was not reviewed in the FEIS. The primary advantages to this route are that it avoids impacts to the important coastal resources associated with the Proposed Route, involves less overall upland impacts than the Proposed Route, is shorter, less costly and has a shorter crossing of the Hudson River.

This route begins where the current proposed route in the Town of Clarkstown, Rockland County crosses the Palisades Interstate Parkway (PIP) 5.0 miles north of the PIP's intersection with I-287. The portion of this route along the PIP to I-287 was evaluated in the FEIS and this variation assumes the route will continue south along the east side of the PIP for another 7.0 miles to a point where the existing 24" Tennessee Gas Pipeline (Tennessee) right-of-way crosses the PIP in an East/West direction. Built in the 1950's, the existing pipeline is part of a larger pipeline system that transports natural gas across northern Pennsylvania and New Jersey before entering into the southern section of Rockland and Westchester Counties.

The Palisades/Dobbs Ferry Alternative 1 would leave the PIP right-of-way at, and then follow, the Tennessee right-of-way and proceed east for 1.3 miles to the bank of the Hudson River. At this point, the pipe would cross the River for a distance of 1.3 miles to the east bank of the Hudson River. The point where the Millennium pipeline would reach the shore is in the vicinity of Wickers Creek, approximately 1200 ft north of the Dobbs Ferry Station.

The upland portion of the Palisades Parkway/Dobbs Ferry Alternative 1 in Westchester County would then follow the Tennessee right-of-way in an easterly direction crossing the Metro North Hudson rail line approximately 200 feet east of the Hudson River shoreline. The route would then follow a northeasterly direction for a distance of 0.5 miles where it will cross Route 9 (Broadway Avenue). At this point, the route follows a southeasterly direction crossing the Ardsley Country Club, then crosses Washington Ave in the northwesterly direction.

The alternate route will then enter the Village of Irvington at Osceola Avenue. The route again crosses the Ardsley County Club and continues northeast to connect to the currently Millennium's Proposed Route. The total length of the upland portion of the Palisades Parkway/Dobbs Ferry Alternative 1 alignment in Westchester County from the east bank of the River to Route 9/9A is 2.28 miles.

The total length of the Palisades Parkway/Dobbs Ferry Alternative 1 route is approximately 16.7 miles. Since Millennium will be using an existing pipeline in Rockland County that extends to the Bowline Point on the west bank of the Hudson River, the comparative length of new construction for the approved Millennium Route is 30.8 miles which results in the Palisades Parkway/Dobbs Ferry Alternative 1 being 14.1 miles shorter, excluding the lateral to the IBM facility.

For photo references, see Appendix A (Photos 1-19).

3.2. Environmental assessment of alternative

The following provides an environmental assessment of this proposed alternative route.

Land Use

As previously noted, this alternative will predominantly be located within the PIP right-of-way on the portion of the route located west of the Hudson River. The PIP is labeled as public park/open space land use on the mapping obtained from the RCDP. Also, information obtained from the National Park Service indicates that the portion of the PIP located in Bergen County, New Jersey is listed on the National Register of Historic Places. However, the Rockland County, New York listing for Historic Places does not include the PIP. The predominant land use along the PIP is residential; however, as described in Section 3.4 of this report, the PIP right-of-way averages approximately 400 feet and in most areas, there is approximately 100 feet of buffer/right-of-way from the edge of the traveled way to the east and west highway boundary. Based on this, there appears to be ample space within the PIP right-of-way so as not to incur disturbances to the residential areas along the PIP during construction and operation of the pipeline.

Based on the RCDP land use mapping, the predominant land use along the section of this alternative that follows the Tennessee pipeline right-of-way is predominantly open space (institutional and public park) with some residential areas located near the intersection with NYS Route 9W and just south of Tallman State Park. Also, the aerial photographs reviewed indicate that the land uses along this alternative between the PIP right-of-way and the Hudson River are predominantly forested open space along the right-of-way with some sparse residences.

The observed and mapped land uses along the portion of this alternative east of the Hudson River consists of predominantly residential and open lands. The open lands are a mix of public park (V. Everit Macy County Park) and private golf course (Ardsley Country Club) and apparently public open space along Wickers Creek just south of Mercy College. This route would follow road right-of-ways through some residential areas on the portion of the route just west of the NYS Route 9 intersection (a new townhouse complex located at The Landing at Dobbs Ferry) and just east of Cyrus Field Road (a residential subdivision known as Irvington Manor).

The land uses along this alternative are similar to those found along the currently approved route (mixed land uses); therefore, impacts with regards to land uses along the alternative and approved routes would be similar. However, this alternative route would avoid critical coastal zone resources, including Haverstraw Bay, the Village of Croton-on-Hudson water supply well field, and the Arboretum, on the east shore of the Hudson River, without substituting equivalent impacts elsewhere.

Water Wells and Ground water Zones

Based on the mapping obtained from the RCDP, this alternative appears to be approximately 600 feet from the St. Constatine Greek Orthodox Church well, located near Marycrest Road, Town of Orangetown and approximately 500 feet from a cluster of three United Water New York (UWNY) wells (UWNY is a private water supplier in Rockland County) located near Elmer Street, Town of Orangetown. Also, ground water protection zones are indicated on the mapping for these wells. These mapped wells are not impacted by the pipeline route, unlike the Proposed Route, which traverses immediately within the Village of Croton-on-Hudson Well Field.

Based on the mapping obtained from the WCDP, there are no mapped wells or ground water zones along the portion of this alternative east of the Hudson River.

Based on the information reviewed, there do not appear to be any direct impacts to wells along this proposed alternative as compared to the potentially significant impacts to the Village's sole source water supply.

Wetlands

Based on the mapping obtained from the RCDP, this alternative would cross a small portion of New York State Freshwater Wetlands (NYSFWs) at Sparkill Creek. It also appears that several small U.S. Fish and Wildlife Service National Wetland Inventory Wetlands (NWI) would be traversed at the Hackensack River crossing, near Tallman State Park and along the west bank of the Hudson River. It appears possible that some of these smaller NWI wetlands could be avoided during more specific routing of this alternative alignment.

Based on the mapping obtained from the WCDP, there are no New York State Freshwater Wetlands (NYSFW) along the portion of this alternative east of the Hudson River. Several areas of potential ACOE jurisdictional (federal) wetlands are located along this alternative as indicated by the presence hydric (wetland) soils on the WCDP mapping and observations made in the field.

Based on the information reviewed, it appears that wetlands will be crossed along this alternative. However, based on visual observations made during this screening evaluation, these wetlands do not appear to be as functionally beneficial as the wetlands located at the Arboretum based on the public and educational use of the Arboretum's wetland, as

discussed in Section 2 of this report, and they can be traversed without significant impact.

Streams (not including Hudson River crossing)
Based on the mapping obtained from the RCDP, this alternative would cross the Hackensack River, the Sparkill Creek, a tributary to the Sparkill Creek and potentially two other minor stream/drainage way crossings on the portion of the alignment west of the Hudson River. The Hackensack River, Sparkill Creek, and the Tributary to Sparkill Creek crossings are likely New York State Department of Environmental Conservation (NYSDEC), U.S Army Corps of Engineers (ACOE) and county jurisdictional crossings.

Based on the mapping obtained from the WCDP, Wickers Creek and North Brook (a Wicker Creek tributary), and the Saw Mill River are the only streams located along the portion of this alternative east of the Hudson River. Based on the alignment of the Tennessee pipeline, it appears that this proposed alternative will only cross the Saw Mill River, which is a NYSDEC and ACOE jurisdictional water body.

Based on the information reviewed, it appears that streams will be crossed along this alternative. However, it does not appear that the streams to be crossed with this alternative would represent a more significant impact than the streams that will be crossed with the approved route. Streams that will be crossed along the proposed route include the Croton River, several crossings of the Saw Mill River, and tributaries to the New Croton Reservoir, a New York City drinking water supply source.

Historic Sites
Based on the mapping obtained from the RCDP, one Dutch Colonial/Federal period site is located near this alternative near the intersection of the alternative and NYS Route 9W; however, it is likely that this site will not be directly impacted by this alternative or could be modified to avoid any impacts. Also, as previously noted, the portion of the PIP located in Bergen County, New Jersey is listed on the National Register of Historic Places. However, the Rockland County, New York listing for Historic Places does not include the PIP.

The mapping obtained from the WCDP did not indicate the presence of historic sites along the portion of this alternative east of the Hudson River; however, information obtained from an internet source describing selected place names for Dobbs Ferry indicates that the area just north of Wickers Creek was the location of a ferry landing. This is the current location of the Tennessee pipeline routing, and as such, has been previously disturbed to some extent. According to the information reviewed, the ferry operated from the early 1700's to the early 1900's. Also, the Old Croton Aqueduct is another historic feature located along this alternative. This aqueduct was completed in 1842 and transmitted drinking water to New York City via an underground tunnel. Once again, the current routing of the Tennessee pipeline crosses this feature and, therefore, has been previously disturbed.

Based on information provided in the FEIS, sixteen sites were identified during cultural resources surveys performed in Westchester County. Information reviewed for this assessment indicates the presence of historic sites near this proposed alternative. Based on this information, it does not appear that impacts to historic sites along the proposed alternative represent a significant increase in impacts as those currently associated with the approved route.

Topography/Rock Outcrops

Based on the mapping obtained from the RCDP and observations made during the site visit, outcroppings are located along the section of this alternative that is south of Tallman State Park near the Hudson River. A steep incline/rock face was also observed along this route just west of the Hudson River; however, it appears that construction of the Tennessee pipeline cut through a majority of this rock thereby potentially minimizing construction impacts through rock for this alternative.

Based on the mapping obtained from the WCDP and observations made during the site visit, outcroppings are located between the Hudson River and NYS Route 9 in the area of the Wickers Creek ravine and in the area between the Ardsley Country Club and the Saw Mill River Parkway. Steep slopes are also located in these two areas.

Based on the available mapping and observations made in the field, steep slopes and areas of outcroppings are also located along the approved route, east of the Hudson. However, it does not appear that steep slopes and rock outcrops along the proposed alternative represent a significant increase in impacts as those currently associated with the approved route.

SEQR Critical Environmental Areas (CEAs)

Based on information obtained from the NYSDEC internet site, there are no CEAs located in Rockland County along this alternative.

Based on information obtained from the NYSDEC internet site and the mapping obtained from the WCDP, County and State Park Lands and the Hudson River are designated CEAs in Westchester County. V. Everit Macy County Park and the Hudson River are CEAs located along the portion of this alternative east of the Hudson River.

Based on the information reviewed, it appears that both the approved route and this proposed alternative will be within Westchester County designated CEAs. It does not appear that these resources will represent a significant difference in impacts between these two routes. However, this alternative route would avoid critical coastal zone resources, including Haverstraw Bay, the Village of Croton-on-Hudson water supply well field, and the Arboretum, on the east shore of the Hudson River, without substituting equivalent impacts elsewhere.

3.3. Method of construction

The method of construction along the PIP would be to install the 24-inch pipe in a trench approximately six feet deep, approximately 20 feet from the curb of the northbound lane.

The Parkway is a four lane, divided highway with a grassed and treed median of varying width. The right-of-way averages approximately 400 feet. In most areas, there is approximately 100 feet of buffer/right-of-way from the edge of the traveled way to the east and west highway boundary. This 100-foot buffer consists of maintained grassed areas with the remainder planted in naturally occurring vegetation, including pine, locust, viburnum, wild flowers and annuals.

Millennium has estimated that installation of the pipeline along the PIP would require the clearing of approximately 15 to 20 feet of trees or approximately 2 acres per mile, an estimate with which O'Brien & Gere concurs. This clearing of 15 to 20 foot of trees and other ground cover would result in a work zone that would be approximately 35 to 40 feet in width. This working width dictates a method of construction, which limits the length of pipe that can be strung out along the roadway, which slows production and increases cost. The pipe will be installed in shorter lengths of approximately 20 to 40 feet.

The proposed method of construction adjacent to the Tennessee right-of-way will be to install the Millennium pipeline 15 feet from the existing Tennessee right-of-way. Preliminary information indicates the Tennessee right-of-way varies from 6 feet to 50 feet wide, and the existing pipe is in the middle. Therefore, the proposed pipe will require securing 30 feet of additional right-of-way for approximately 1.3 miles in Rockland County and 20 feet more right-of-way for approximately 2.3 miles in Westchester County.

The method of installation across the Hudson River could be either lay barge or directional drilled methods since there is 0.5 acres available on both sides of the River. There is adequate room on the west side of the River to stage a directional drilled pipe assembly area and approximately one acre on the east side to accommodate the drilling equipment.

There are several roads that either cross over or under the PIP. The proposed pipeline could be installed by a conventional bore or jacked operation across these roads so that traffic will not be impacted.

3.4. Costs

Millennium has developed an average cost per mile for construction of the 24-inch pipe throughout Rockland and Westchester County. This cost is $1,937,573 per mile (Exhibit K, Docket Number CP98-350-000, "Millennium Pipeline Company, L.P., Cost of Facilities").

The installation of a pipeline adjacent to a busy roadway would be slower than the average production rate along the approved Millennium route. To account for this loss of production O'Brien & Gere has applied a 1.5 difficulty factor to Millennium's average cost, based on O'Brien & Gere's experience. Therefore, for the purposes of this evaluation, it has been assumed that construction costs will be $2,906,000 per mile. Using the Palisades Parkway/Dobbs Ferry Alternative 1 length of 16.7 miles, the estimated construction cost would be approximately $49 million. The corresponding cost of the Proposed Route from Bowline Point to the vicinity of Dobbs Ferry would be approximately $59 million dollars using Millennium's average cost per mile of $1,937,573. Therefore, there is a saving of approximately $10 million in using the Palisades Parkway/Dobbs Ferry Alternative 1.

The crossing for this alternative is 6800 feet compared to 11,500 feet for the proposed route. In addition, this crossing appears to have fewer environmental impacts, which will result in lower costs.

Please see Appendix B for a cost breakdown of this Alternative

3.5. Overall assessment

Based on the information reviewed for this environmental assessment of proposed alternatives, it appears that the Palisades/Dobbs Ferry Alternative 1 presents a viable alternative, with regards to environmental impacts, to Millennium's approved route that do not substitute significant environmental impacts at a new location as the price for avoiding impacts to the critical coastal zone resources of Haverstraw Bay, the Village of Croton-on-Hudson water supply well field, and the Arboretum. In general, this alternative route presents a net reduction in

significant environmental impacts combined with a construction cost savings to the project sponsor. As such, implementation of an appropriate alternative as presented in this evaluation will result in a favorable outcome to the environmental resources of the coastal zone and to the project sponsor.

For more information about the maps referred/attached to this document, please send an email inquiry to gcos.inquires@noaa.gov.

4. Palisades/Dobbs Ferry Alternative 2

4.1. Route description

The "Palisades/Dobbs Ferry Alternative 2" (Figure 4.1), as developed for this evaluation, is a variation of the Palisades/Dobbs Ferry Alternative 1.

The Palisades/Dobbs Ferry Alternative 2 is identical to the Palisades/Dobbs Ferry Alternative 1 north of I-287. Alternate 2 differs in that it continues east from the intersection of the PIP and I-287 along the north side of I-287 until it intersects the Conrail Railroad. The pipeline would then follow the East Side of the railroad rights-of-way for a distance of 5.65 miles until the railroad right-of-way intersects the existing Tennessee right-of-way approximately 400 feet south of the New York State/New Jersey line. At this point, the route would proceed east along the Tennessee right-of-way for 2.7 miles to the west bank of the Hudson River. From this point, the alignment is identical to the Palisades/Dobbs Ferry Alternative 1.

The total length of Alternative 2 is approximately 18.5 miles or 2.1 miles longer than the Palisades/Dobbs Ferry Alternative 1. Alternative 2 is approximately 15.8 miles shorter than the Proposed Route from Bowline Point to where this Alternative intersects the Proposed Route east of the Saw Mill River Parkway, in Dobbs Ferry.

For photo references, see Appendix A (Photos 19, 20-23)

4.2. Environmental assessment of alternative

The following provides an environmental assessment of the portion of this proposed alternative route that follows the Penn Central railroad right-of-way. The portion of this alternative route from the PIP intersection through Saw Mill River intersection is identical to the Palisades/Dobbs Ferry Alternative 1.

Land Use

This alternative will predominantly be located within the Penn Central railroad right-of-way, which is labeled as railroad on the land use mapping provided by the RCDP. Land use along the railroad right-of-way varies but is predominantly commercial/industrial and residential; however, based on site observations and information provided in Section 4.4 of this report, the rail road right-of-way varies in width from 50 feet to 130 feet. Based on this and the anticipated 40 foot work zone requirement (Section 4.4) a temporary construction easement would need to be secured in selected areas along the railroad rights-of-way.

Based on the RCDP land use mapping, the land use along the section of this alternative that follows the Tennessee pipeline right-of-way between the railroad and the PIP is a mix of residential/commercial and open space (institutional and public park). Land use along this alternative from the PIP to the Saw Mill River intersection is the same as that described for the Palisades/Dobbs Ferry Alternative 1.

The land uses along this alternative are similar to those found along the currently approved route (mixed land uses); therefore, impacts with regards to land uses along the alternative and approved routes would be similar. However, this alternative route would avoid critical coastal zone resources, including Haverstraw Bay, the Village of Croton-on-Hudson water supply well field, and the Arboretum, on the east shore of the Hudson River, without substituting equivalent impacts elsewhere.

Water Wells and Ground Water Zones
Based on the mapping obtained from the RCDP, this alternative appears to be approximately 300 feet from a well for the Nyack Water Company, located just north of Route 59 and east of the railroad right-of-way in the Town of Clarkstown; approximately 250 feet from a UWNY well located near Garfield and Hayes Street, Town of Orangetown; and approximately 900 feet from a well for JJ Dodge Community located east of Route 303 near Kings Highway and Greenbush Road, Town of Orangetown. Also, ground water protection zones are indicated on the mapping for these wells. The proposed alignment traverses through these zones. These mapped wells appear to be offset from the railroad right-of-way and thus offset from this pipeline alternative, unlike the current pipeline alignment, which traverses immediately within the Village of Croton-on-Hudson well field. Wells along this alternative from the PIP to the Saw Mill River intersection are the same as that described for the Palisades/Dobbs Ferry Alternative 1.

Based on the information reviewed, there do not appear to be any direct impacts to wells along this proposed alternative.

Wetlands
Based on the mapping obtained from the RCDP, this alternative would cross portions of NYSFW's at the Sparkill Creek and Hackensack River crossings. Wetlands along this alternative from the PIP to the Saw Mill River intersection are the same as that described for the Palisades/Dobbs Ferry Alternative 1.

Based on the information reviewed, it appears that wetlands will be crossed along this alternative. However, these wetlands do not appear to be as functionally beneficial as the wetlands located at the Arboretum based on the public and educational use of the Arboretum's wetland, as discussed in Section 2 of this report.

Streams (not including Hudson River crossing)
Based on the mapping obtained from the RCDP, this alternative would cross the Hackensack River, the Sparkill Creek, two small tributaries to

the Sparkill Creek and potentially three other minor stream/drainage way crossings. The Hackensack River, Sparkill Creek, and Tributaries to Sparkill Creek crossings are likely NYSDEC, ACOE and county jurisdictional crossings. Stream crossings along this alternative from the PIP to the Saw Mill River intersection are the same as that described for the Palisades/Dobbs Ferry Alternative 1.

Based on the information reviewed, it appears that streams will be crossed along this alternative. However, it does not appear that the streams to be crossed with this alternative would represent a more significant impact than the streams that will be crossed with the approved route. Streams that will be crossed along the proposed route include the Croton River, the several crossings of the Saw Mill River, and tributaries to the New Croton Reservoir, a New York City drinking water supply source.

Historic Sites

Based on the mapping obtained from the RCDP, five Dutch Colonial/Federal period sites, four Revival/Victorian period sites, and the Tappan Village Historic District are located along this alternative alignment. Based on the location of these resources, it is likely that these sites will not be directly impacted by this alternative. Historic sites along this alternative from the PIP to the Saw Mill River intersection are the same as that described for the Palisades/Dobbs Ferry Alternative 1.

Based on information provided in the FEIS, sixteen sites were identified during cultural resources surveys performed in Westchester County. Information reviewed for this assessment indicates the presence of historic sites near this proposed alternative. Based on this information, it does not appear that impacts to historic sites along the proposed alternative represent a significant increase in impacts as those currently associated with the approved route.

Topography/Rock Outcrops

Based on the mapping obtained from the RCDP and observations made during the site visit, outcroppings and steep slopes are not located along the section of this alternative prior to the PIP. Outcroppings and steep slopes along this alternative from the PIP to the Saw Mill River intersection are the same as that described for the Palisades/Dobbs Ferry Alternative 1.

Based on the available mapping and observations made in the field, steep slopes and areas of outcroppings are also located along the approved route, east of the Hudson. However, it does not appear that steep slopes and rock outcrops along the proposed alternative represent a significant increase in impacts as those currently associated with the approved route.

SEQR Critical Environmental Areas (CEAs)

Based on information obtained from the NYSDEC internet site, there are no CEAs located in Rockland County along this alternative. CEAs along this alternative from the PIP to the Saw Mill River intersection are the same as that described for the Palisades/Dobbs Ferry Alternative 1.

Based on the information reviewed, it appears that both the approved route and this proposed alternative will be within Westchester County designated CEAs. It does not appear that these resources will represent a significant difference in impacts between these two routes.

4.3. Method of construction

The pipeline would be installed within a casing approximately 30 feet from the center line of the tracks. The depth of cover would have to be increased over that required for parallel highway works.

The width of the work zone would be approximately 40 feet, which would require the securing of temporary construction easements in selected areas along the railroad rights-of-way. The right-of-way width varies from 50 feet to 130 feet.

4.4. Costs

The average cost per mile of $2,906,000, as used in this evaluation, would apply to all areas except construction within the railroad right-of-way. The average cost to construct within the railroad right-of-way is assumed to be $3,800,000 per mile based on O'Brien & Gere experience with railroad requirements. Therefore, the cost for the Palisade/Dobbs Ferry Alternative 2 would be approximately $59 million which would be the same cost as the corresponding cost for the approved Millennium route from Bowline Point to the vicinity of Dobbs Ferry, or likely less costly than Millennium's proposed route since the estimates herein are highly conservative.

The Palisades/Dobbs Ferry Alternative 2 would be a preferable route to the Millennium's Proposed Route since it (a) is technically feasible, (b) avoids significant impacts to sensitive environmental resources, and (c) is equal to or less expensive in cost than the Millennium Proposed Route.

Please see Appendix B for a cost breakdown of this Alternative.

4.5. Overall assessment

Based on the information reviewed for this environmental assessment of proposed alternatives, it appears that the Palisades/Dobbs Ferry Alternative 2 presents a viable alternative, with regards to environmental impacts, to Millennium's approved route that do not substitute significant environmental impacts at a new location as the price for avoiding

impacts to the critical coastal zone resources of Haverstraw Bay, the Village of Croton-on-Hudson water supply well field, and the Arboretum. In general, this alternative route presents a net reduction in significant environmental impacts combined with a construction cost savings to the project sponsor. As such, implementation of an appropriate alternative as presented in this evaluation will result in a favorable outcome to the environmental resources of the coastal zone and to the project sponsor.

For more information about the maps referred/attached to this document, please send an email inquiry to gcos.inquires@noaa.gov.

5. Hudson River South "Clarkstown/Route 117" Alternative

5.1. Route description

The alignment of the Hudson River South "Clarkstown/Route 117" Alternative (Figure 5.1) is common to the Palisades/Dobbs Ferry Alternative 2 until it reaches the Exit 12/State Route 303 intersection in Nyack. From this point, the pipeline would turn northward and parallel to Route 303 for approximately 3,600 feet. From there, it would turn northeastward for a distance of approximately 11,300 feet to the Nyack Beach State Park. This alignment crosses wooded lands and would require a new right-of-way approximately 50 ft wide for the length of this southern alternative variation. On the west bank of the Hudson River, a lay barge pipeline crossing operation would commence at the southern extremity of the Nyack Beach State Park (see Appendix A). The pipeline would proceed across the Hudson River for a distance of approximately 12,000 ft to the Rockwood Hall State Park. From there, it would follow the alternative route proposed by the members of NUMB which is referred to as the "Route 117" Alignment in the FEIS. This O'Brien & Gere variation of the Millennium Pipeline alignment avoids the construction of the pipeline from Croton-on-Hudson to a point where Route 117 intersects the Taconic State Parkway. The impacts to the Croton-on-Hudson's Well Field are avoided, as are impacts to sensitive ecological resources in the vicinity of the Village. This option was not given any consideration by Millennium, even though it significantly minimizes impacts to sensitive coastal zone resources.

The total length of this alternative is 15.6 miles, and the corresponding length of the approved Millennium's route from Bowline to the Route 117 point of intersection is approximately 26.3 miles. Therefore, this route is approximately 10.7 miles shorter than that proposed by Millennium.

For photo references, see Appendix A (Photos 1-3, 24-33).

5.2. Environmental assessment of alternative

The following provides an environmental assessment of this proposed alternative route from the I-287 intersection to the Hudson River crossing.

Land Use

The observed and mapped land uses along this alternative consists of predominantly residential and vacant lands. Public (Nyack Beach State Park) and private open space areas are also located along this alternative.

The land uses along this alternative are similar to those found along the currently approved route (mixed land uses); therefore, impacts with regards to land uses along the alternative and approved routes would be similar. However, this alternative route would avoid critical coastal zone resources, including Haverstraw Bay, the Village of Croton-on-Hudson water supply well field, and the Arboretum, on the east shore of the Hudson River, without substituting equivalent impacts elsewhere.

Water Wells and Ground Water Zones
Based on the mapping obtained by the RCDP, there are no mapped wells or ground water zones along this alternative. Therefore, there will be no impacts to ground water supply resources from this routing option. This is in sharp contrast to Millennium's Proposed Route, which has the potential for significant impairment or loss of the Village's Well Field and water supply.

Based on the information reviewed, there do not appear to be any direct impacts to wells along this proposed alternative.

Wetlands
Based on the mapping obtained by the RCDP, there are no NYSFW along this alternative. Several small ponds are depicted on the mapping and are indicated as NWI wetlands. It appears that these could be avoided during more specific routing of this alternative alignment.

Wetlands along the Hudson River South "Clarkstown/Route 117" Alternative can be crossed by routine construction techniques without long term impairment; visual observations made during this screening assessment indicated that these wetlands are not functionally unique or unusual. This is in contrast to the ecological and educational values of the Jane E. Lytle Memorial Arboretum that will be significantly reduced using Millennium's Proposed Route. Millennium has offered no potential mitigation, such as directional drilling to avoid impacting the Arboretum and its unique local resources.

Streams (not including Hudson River crossing)
Based on the mapping obtained from the RCDP, there are no county regulated streams along this alternative. However, there are as many as three potential small stream crossings along this alternative. These streams are likely NYSDEC and/or ACOE jurisdictional water bodies.

Based on the information reviewed, it appears that streams will be crossed along this alternative. However, it does not appear that the streams to be crossed with this alternative would represent a more significant impact than the streams that will be crossed with the approved route. Streams that will be crossed along the proposed route include the Croton River, several crossings of the Saw Mill River, and tributaries to the New Croton Reservoir, a New York City drinking water supply source. Also, this alternative route would avoid critical coastal zone resources, including Haverstraw Bay, the Village of Croton-on-Hudson

water supply well field, and the Arboretum, on the east shore of the Hudson River, without substituting equivalent impacts elsewhere.

Historic Sites
Based on the mapping obtained by the RCDP, four Revival/Victorian period sites are located near this alternative; however, it is likely that these sites will not be directly impacted by this alternative or the alternative could be modified to avoid impacts.

Based on information provided in the FEIS, sixteen sites were identified during cultural resources surveys performed in Westchester County. Information reviewed for this assessment indicates the presence of historic sites near this proposed alternative. Based on this information, it does not appear that impacts to historic sites along the proposed alternative represent a significant increase in impacts as those currently associated with the approved route. Therefore, this alternative route would avoid critical coastal zone resources, including Haverstraw Bay, the Village of Croton-on-Hudson water supply well field, and the Arboretum on the east shore of the Hudson River, without substituting equivalent impacts elsewhere.

Topography/Rock Outcrops
Based on the mapping obtained by the RCDP and observations made during the site visit, outcroppings are located between Route 303 and NYS Route 9W as well as in the vicinity of Nyack Beach State Park. Several steep inclines/rock faces were also observed along this route, generally in the area of the outcroppings.

Based on the available mapping and observations made in the field, steep slopes and areas of outcroppings are also located along the approved route, east of the Hudson. However, it does not appear that steep slopes and rock outcrops along the proposed alternative represent a significant increase in impacts as those currently associated with the Proposed Route.

SEQR Critical Environmental Areas (CEAs)
Based on information obtained from the NYSDEC internet site, there are no CEAs located along this alternative.

Based on the information reviewed, it appears that both the approved route and this proposed alternative will be within Westchester County designated CEAs. It does not appear that these resources will represent a significant difference in impacts between these two routes.

5.3. Method of construction

At the point where the Hudson River South "Clarkstown/Route 117" Alternative leaves I-287, the pipeline would be constructed in a 6 foot deep trench located approximately 10 feet from the edge of the southbound shoulder of Route 303.

A 36-inch steel casing would be installed beneath Route 303 at the point of crossing by a conventional bored method and the 24-inch diameter gas line inserted within the 36-inch casing. Once the pipe is across Route 303, the pipe would be installed in the center of a 50 foot wide easement until it reached the point of crossing the Hudson River in the south end of Nyack Beach Park.

The river crossing installation would be by lay barge technique to the eastern bank for a distance of approximately 2.3 miles. The Metro Rail Tracks could be crossed with a directional drilling technique that would require stringing the pipe in the River and pulling eastward into the Rockwood Hall State Park.

The balance of the alignment through the Rockwood Hall State Park would be installed in a 6 foot deep trench within a 30 foot easement to Route 9 where the pipeline would be installed by a bore method in a 36-inch diameter casing. The balance of the route (2.8 miles) would be installed adjacent to the North side of Route 117 keeping a minimum separation between the west bound lane and the pipe of approximately 20 feet.

5.4. Costs

The average cost per mile for roadside construction is $2,906,000 per mile would apply to approximately 10.7 miles, and the average cost for areas outside of roadways is $1,938,000 and would apply to 4.9 miles.

The estimated cost for the Hudson River South, Clarkstown, Route 17. Alternative is approximately 40.3 million dollars.

By contrast, the estimated cost of the corresponding approved 26.3 mile Millennium route would be 50.9 million dollars, or at least 10 million dollars more than this option.

Please see Appendix B for a cost breakdown of this Alternative.

5.5. Overall assessment

Based on the information reviewed for this environmental assessment of proposed alternatives, it appears that the Hudson River South "Clarkstown/Route 117" Alternative presents a viable alternative, with regards to environmental impacts, to Millennium's approved route that do not substitute significant environmental impacts at a new location as the price for avoiding impacts to the critical coastal zone resources of Haverstraw Bay, the Village of Croton-on-Hudson water supply well field, and the Arboretum. In general, this alternative route presents a net

reduction in significant environmental impacts combined with a construction cost savings to the project sponsor. As such, implementation of an appropriate alternative as presented in this evaluation will result in a favorable outcome to the environmental resources of the coastal zone and to the project sponsor.

6. Hudson River North – Alternatives 1 and 2

6.1. Route description

The Hudson River North Alternatives 1 and 2 were developed by Millennium to avoid crossing the Hudson River through Haverstraw Bay, but were then dismissed from further consideration.

The Hudson River North Alternative 1 would deviate from the proposed route near the Ramapo Station at mile point 377.9 and would turn northeast adjacent to the Algonquin pipeline and ConEd power line rights-of-way. The alternative would continue adjacent to these rights-of-way about 10.0 miles to the Hudson River, which is about 5,400 feet wide (1.0 mile) at the alternative crossing. Alternative 1 would cross the Hudson River adjacent to the Algonquin pipelines and would continue east adjacent to the pipeline right-of-way for about 0.9 mile to the ConEd right-of-way. Alternative 1 would then turn southeast adjacent to the ConEd powerline and continue for about 1.4 miles to rejoin the proposed route at mile point 391.7. Alternative 1 would be adjacent to existing rights-of-way for all but about 700 feet. This alignment is described in detail in Section 6, pages 6-3 to 6-5 of the FEIS.

The Hudson River North Alternative 2 begins at mile point 393.3 and would include construction along the proposed route to about mile point 385.4 (2.1 miles). At that point, Alternative 2 would deviate onto a power line right-of-way that turns west from the proposed route. Alternative 2 would be adjacent to the power line for about 1.1 miles and then would turn north onto new right-of-way for about 3.0 miles until it joins Alternative 1, about 0.7 mile northeast of the PIP. From that point on, Alternative 2 would follow the same route as Alternative 1.

After leaving the proposed route at mile point 385.4, Alternative 2 would cross 0.3 mile of the adjacent of the PIP to the power line right-of-way. After crossing U.S. Route 202, the alternative would leave the power line right-of-way and continue on new right-of-way through a residential subdivision near Hammond Road, a park that was once part of the Letchworth Village State Mental Hospital, the Letchworth Village Development Center, a residential development off Willow Grove Road, a municipal park, and another residential development off Cedar Pond Road. Elements of the Letchworth Village are considered potentially eligible for listing on the NRHP. Alternative 2 would join Alternative 1 south of Cedar Pond Road.

6.2. Millennium's conclusions

Millennium concluded Alternatives and 2 would not be feasible for the following reasons:

- Several subdivisions are in close proximity to the existing ConEd and Algonquin rights-of-way;
- The proposed route could not follow the existing ConEd and Algonquin rights-of-way; and
  These subdivisions thence requiring a reroute.

O'Brien & Gere's response to the above conclusions is that in some areas adjacent to homes, such as that shown in Photo 34 (in Appendix A), specialized construction techniques could be used to install the pipe. One such technique would be to construct the pipeline on the opposite side of the existing right-of-way placing it further from existing homes. In the area shown in Photo 35, the opposite side of the right-of-way is a slope of approximately 1 horizontal to 1 vertical slope. To avoid significant impacts to the slope, a bench of approximately 12 feet in width could be cut into the bank, and the pipe installed in this bench using the method, whereby short lengths of 40 feet are installed.

In other areas, the proposed pipe could be located closer to the existing Algonquin pipelines and constructed using the stove pipe method which requires a 35 to 40 wide construction zone in lieu of the cross county installation width of 75 feet. The pipeline would have to meet the standards established by the industry and/or ordinances for setbacks from residential homes. Also the directional drilled technique could be used to minimize construction in close proximity to homes.

FERC concluded in Volume 1 of the FEIS (p. 6-4, paragraph 2) that between Route 9W and the west bank of the Hudson River:

> "Alternative 1 would be in an area that is extremely congested and also characterized by steep slope. In addition to the Algonquin pipelines, there is a power line. Parallel to the Hudson River, there is a two-lane road, two tracks for an active railroad at the River edge, and possibly a water line. Because there is also a residence in this area, and Algonquin aboveground facilities (pig launcher/receiver and block valves), Millennium states that there would not be enough work space to stage either a conventional or a directionally drilled crossing of the river at this location. In addition, because of the length of the crossing (1.0 mile), a directional drill at this location would probably be infeasible because setback from the River for staging, and to allow for the required pipe curvature and drilling depth, would make the length of a directional drill beyond technical capabilities."

O'Brien & Gere's response to the above conclusions is that while the area is not suitable for the siting of directional drilling equipment that is required to drill a hole and pull the pipe back from the east side of the River, there is room to stage a lay barge operation combined with a conventional bored and cased crossing of the frontage road and railroad tracks. The lay barge staging area requires an area of approximately 150-foot by 150 foot. A section of this area is shown as Appendix C. This stretch of the Hudson River is not as sensitive ecologically as Haverstraw bay and, therefore, a lay barge crossing would be appropriate at this location.

In Volume of the FEIS (p. 6-4, paragraph 3), FERC stated the following:

> "On the east bank of the Hudson River, Alternative 1 would be between the Indian Point Nuclear Generating Station and the LaFarge Gypsum Plant. This area also has limited work space because of the existing industrial facilities, the steep, rock faced shoreline, Algonquin's aboveground facilities (mainline valves), a natural drainage and associated wetlands, and ship moorings along a second drainage. Beyond the east shore, the alternative would include crossing State Route 9A (with a bride crossing), a railroad, and commercial and residential development areas."

O'Brien & Gere's response to the above is that there is an open area south of the LaFarge Gypsum Plant that could be used as a staging area to accommodate a lay barge method of crossing the River (see Photos 36 & 37).

Under Section 6.1.1 of the FEIS (p. 6-5, paragraph 5), FERC makes the following comments regarding the Hudson River North Alternative 2:

> "Alternative 2 would require significant amounts of in-street construction through existing residential subdivisions and residential subdivisions under development. It would also have the same problems with staging the crossing of the Hudson River, and it would have the same land use impacts as Alternative 1 from a point about 0.7 mile northeast of the PIP across the Hudson River to the interconnection with the proposed route near mile point 391.7, since both would follow the same path. Because of these issues, we do not recommend further analysis of the feasibility or use of this alternative."

O'Brien & Gere's response to the above is that construction within residential streets can be performed using the method of installing one short section of pipe at a time. This type of construction requires more special conditions that cross county type of construction (*i.e.*, existing utility support or relocation, traffic control, limited working time, and more complex restoration types) but is nonetheless feasible from a construction standpoint. Millennium will be constructing portions of its conditionally approved route through streets in Westchester County and can use the same technique along Alternatives 1 & 2. The in street

construction is significantly more expensive than the average cost per foot for the Millennium project, but these costs must be balanced against the avoidance of crossing Haverstraw Bay and the lower cost of the shorter crossing of the Hudson River for Alternatives 1 and 2.

7. Navigation Channel Alternative

7.1. Route description

The Navigation Channel Alternative (Figure 7.1) is another routing alternative that has not been identified or reviewed by FERC or Millennium to date, which would avoid construction impacts in the more ecologically sensitive, untouched eastern portions of Haverstraw Bay, in addition to the Croton-on-Hudson Well Field and the Jane E. Lytle Memorial Arboretum.

The alignment would begin at a point of connection to the existing 24-inch gas pipeline at Bowline Point and proceed north for approximately 0.6 miles to a point of crossing on the west banks of the Hudson River. From the west bank, the pipeline would proceed due east for approximately 3500 feet to the Navigation Channel, then southerly for approximately 45,000 feet to a point where it would join the Hudson River South "Clarkstown/Route 117" Alternative. The balance of the Navigation Channel Alternative would follow the Hudson River South, Clarkstown, Route117 alignment for a distance of approximately 4.7 miles. The total length of this route is approximately 13.2 miles.

7.2. Method of construction

The method of construction for the in-river portion would be lay barge method as described by FERC in the FEIS. The direction drilled method would also be feasible for the sections between the Navigation Channel and the west and east banks of the River conditioned upon receiving permission to string the pipe in the River and pull from both banks.

The upland portion of the alignment in Westchester County would be the same as that described in the Hudson River South "Clarkstown/Route 117" Alternative.

7.3. Costs

The estimated cost for the Navigational Channel Alternative is 72.9 million dollars based on an average per foot cost of $1,200. This cost is shown in Appendix B. The estimated cost of the corresponding approved Millennium route is $50.9 million dollars.

7.4. Overall assessment

The Navigation Channel Alternative is feasible from a construction standpoint, and would avoid significant to onshore coastal resources along the east bank of the Hudson River. This Alternative would also serve to reduce the scale of impacts to significant habitat in Haverstraw Bay by avoiding the more ecologically valuable eastern portions of Haverstraw Bay. In-river construction would take place largely within the navigation channel, which has been previously disturbed by routine maintenance dredging. Depending on the method of construction from Bowline Point to the navigation channel, however, regulatory approvals would be required for either the reduced-scope lay barge dredge (that would avoid the need for blasting) in eastern Haverstraw Bay, or for a partial directional drill and the associated discharges of drilling mud and pipe stringing activities.

8. Partial Haverstraw Bay Directional Drill

This option was evaluated and dismissed from further evaluation in the FEIS. FERC's evaluation is as follows:

> "This option would avoid disturbance of the Hudson River shorelines. It would require setting up drilling equipment on both shorelines. The pipe for the west shore would be welded on a barge and then stages (laid) on the riverbottom before being pulled back through the drill hole to the west bank. Because of the rock/soil interface, the pipe for the east shore would be staged on the east bank and then pulled through the drill hole from the bank to the exit hole in the river. The two segments would then be welded to the rest of the river crossing pipe.
>
> Millennium does not believe that a directional drill of the shorelines is a feasible or reasonable option for the following reasons:
>
> - On the west bank, the relative consistency of the soils may make maintenance of the exit hole very difficult and would pose a substantial risk to the successful completion of the drill. The directional drill would require staging of the drilling equipment on the west bank and about 3,000 feet of pipe in the river east of the exit hole.
> - On the east bank, significant grading within the Franklin D. Roosevelt Veteran's Hospital would be required to prepare a relatively level 1-acre work space for the staging of the directional drilling equipment.
> - Directional drilling includes the use of drilling mud, which consists of about 5 percent bentonite and the rest water. Normally, the drilling mud is circulated between the drill and the exit holes. In this case, once the pilot hole is completed, drilling fluid would be discharged continuously into the riverbed at the exit holes until pipe installation is completed. Millennium estimates that drilling fluid, consisting of about 1,800 cubic yards of bentonite, 900 cubic yards of drilled spoil, and 255,000 barrels of fresh water would be discharged at each exit hole (a total discharge of 5,400 cubic yards into the River).
>
> The sequential crossing of the Hudson River/Haverstraw Bay by means of two directionally drilled shore approaches and a lay barge in the middle would likely increase the duration of construction from 3 to 4.5 months."

O'Brien & Gere's response to the above issues are as follows:

> The maintenance of the exit hole and the likelihood of a successful installation are enhanced by drilling from the east and west banks with the exit hole in the middle of the River.

Cherrington's preliminary analysis indicates that conventional horizontal directional drilling could be used subject to better subsurface information.

There is ample room available on both banks of Haverstraw Bay to stage a partial directional drilled crossing of two separate sections of pipe each approximately 5500 feet long.

There is adequate land available within the Franklin D. Roosevelt Veteran Hospital grounds to permit the grading required to set the drilling equipment.

The exiting of drilling mud is an issue that should be formerly addressed by the regulatory agencies.

- Since there will not be a surface disturbance to the more sensitive shoreline areas of the Bay, the duration of a directionally drilled crossing may not be critical.

The estimated cost of the partial River crossing is approximately the same as a full crossing. This cost is estimated to be between 20 to 25 million dollars for Haverstraw Bay. The implementation of this method would avoid the sensitive ecological resources in Haverstraw Bay.

A partial crossing of the Hudson River could be used to cross the eastern portion of Haverstraw Bay only, and use the open cut (lay barge) method for the balance of the crossing. This plan would minimize the impacts of blasting and other impacts caused by open cutting the eastern portion of the Bay.

Partial drilling could also be used to reach the navigation channel for the Navigational Channel Route Alternative. This application would be especially beneficial to drill from the Rockefeller Preserve beneath the railroad and steep River banks to the center of the River.

A final decision to use the partial directional drill method can only be made after a detailed evaluation of the site.

9. Directional drill of Haverstraw Bay

A directional drilled crossing of Haverstraw Bay would involve drilling a small diameter pilot hole underneath the Bay and then enlarging the pilot hole until the hole is large enough to accommodate the 24-inch diameter pipe. This technique requires a staging area on both banks of the Bay. Normally approximately one acre is required on one bank and an area approximately 50 feet wide and the length of the crossing is required on the opposite bank.

Millennium concluded that a directional drilled crossing of Haverstraw Bay is not feasible due to the following:

The proposed crossing would be 2.1 miles long, making directional drilling infeasible as a construction option.

- There is not adequate room on either side of Haverstraw Bay to string a 2.1 mile long section of 24-inch steel pipe.

O'Brien & Gere's investigation of the use of the directional drilled technique included consultation with Cherrington Corporation of Sacramento, California, an experienced directional drilling contractor and a recognized expert in the industry (see Appendix D).

O'Brien & Gere also consulted with Mueser Rutledge Consulting Engineers, Inc. of New York City which has extensive experience with subsurface exploration and who are presently providing geotechnical consulting on the proposed Tappan Zee Bridge crossing in the vicinity of the proposed Millennium pipeline. Mueser Rutledge also furnished subsurface information on several other projects in the vicinity of the Millennium proposed crossing of the Hudson River.

Cherrington's preliminary analysis for the Haverstraw Bay Pipeline Crossing considered two methodologies after reviewing the geotechnical information. (See Appendix E for Cherrington's Feasibility Analysis). These methods are:

- An Enhanced Conventional Horizontal Directional Drilled (HDD) System
  EBB System (Environmental Beneficial Boring)

The enhanced conventional HDD planned execution involves the conventional pilot hole pre-ream and pull back technique. Modifications to today's conventional HDD system required to construct a 2.1 mile crossing include:

Higher torque and thrust capacities

- Larger diameter/higher torque in-hole tools which are all relative evolutionary changes, identical to what has taken place in the past

Cherrington's analysis contemplated drilling through a limited amount of rock on both sides of the Hudson River and penetrating the clay and silt formations existing in the middle. These soft alluvial formations, which are found throughout the middle of the River, create an environmental concern for a 2.1 mile crossing since there will be a loss of drilling fluid circulation while drilling through these soft zones. This loss of circulation has the potential of fracturing to the bottom of the river.

The EBB System, which is not widely used, was first introduced to crossing under rivers in 1977. This river crossing system has several very unique characteristics. Basically, it is a one step process similar in nature to that of drilling a pilot hole in the conventional HDD drilling operation. However, in the EBB System's one step process, a relatively large (36-inch) diameter pipe is used either as a casing or the product pipe. Several smaller internal pipes are placed within the larger pipe which are used to perform various functions. Simply speaking, the larger diameter pipe is used as the drilling string, eliminating the need for either the reaming phase or the pipe pull back phase as in the conventional HDD operation. If the large pipe is used as a casing, then the desired diameter product pipe can be pulled through the casing pipe.

The combination weight of the 36-inch pipe plus the added weight of the internal pipes with their respective contents inside results in a zero or near neutral buoyancy of the structure. This allows greater distances to be achieved as the frictional forces along the pipe are reduced significantly. The EBB's use of the larger 36-inch diameter pipe allows a much higher column loading on the pipe which enables much greater distances to be achieved.

The most important features is that the drilling fluid that is expelled through the bit is drained back into the 36-inch pipe and internally pumped back to the surface where it can be cleaned and reused. The pump used in this process is infinitely controlled allowing the annulus pressure to be maintained at an ideal range well below the formation pressure that may cause exiting of the drilling mud.

Cherrington Corporation recognized that a project of this magnitude is completely outside the realm of conventional HDD technology as used today. However, with specific enhancements to the conventional HDD technology 11,000' is achievable although the environmental ramifications with fracture potentials exists. The technological advancements with the EBB System make HDD crossings 11,000 and beyond achievable and more importantly, these technology advancements also negate the environmental ramification, by design. A final decision to use the directional drill method of construction can only be made after a detailed evaluation of the site.

Cherrington also concluded that with the improvements in equipment, it would be possible to assemble the 24-inch pipe in 1000 foot sections as it is being pulled across the River. Therefore, there is ample room on the east side of Haverstraw Bay, in the VA Hospital Grounds, to permit the staging for the implementation a directional drilled method.

9.1. Costs

The estimated construction cost for a 2.1 mile crossing is as follows:

Enhanced Conventional HDD $20,000,000 to $22,000,000
Estimated Schedule: 280 days (320 Wrk. days per year)

EBB System $15,000,000 to $18,000,000
Estimated Schedule: 190 days (320 Wrk. days per year)

The cost for directional drilling ranges from 2 to 2.5 times that of an open cut, lay barge method, which in the case of Haverstraw Bay could be 12 to 15 million dollars in additional cost over the lay barge method. The benefit would be the avoidance of sensitive ecological resources in the Bay.

A final decision to use the directional drill method of construction can only be made after a detailed evaluation of the site.

10. Westchester Upland Alternatives

10.1. Alternative to avoid the Jane E. Lytle Memorial Arboretum

O'Brien & Gere recommends that the directional drilled method of construction be used to install the 24-inch diameter gas pipeline beneath the Arboretum. The use of this method of construction will result in the pipe being located 20 to 40 feet below the surface for a distance of 1000 feet thus avoiding any disturbance to the Arboretum.

The installation of the directional drilled pipe will require that the drilling equipment be located 100 feet west of the Arboretum in an area approximately 1 acre. The pipe will be assembled outside the Arboretum area to the east. The estimated time to complete for this installation will be one month.

The advantages to directional drilling this 1000-foot section are as follows: (a) It avoids the removal of mature forest at the Arboretum, (b) Impacts to the forested wetland (W08CT) will be mitigated, (c) Disturbance of soils, in both upland and wetland areas, would also be reduced.

The cost of the directional drilled installation will be 6 to 10 times the cost of an open cut method Ref Table 5.3.2.3-4 (Volume 1 – FEIS). The estimated construction cost for the directional drilled installation will be approximately $800 per foot.

10.2. Alternative to avoid the Croton-on-Hudson Well Field

As mentioned in previous sections, Millennium has proposed to install the 24-inch pipeline along the ConEd offset through Westchester County. As described in Section 2, adverse effects from pipeline construction are potentially substantial within this area.

O'Brien & Gere has identified two alternative routes to avoid the Well Field. The first route would circumvent the Well Field to the northeast through heavily treed areas for a distance of approximately 2000 feet, which is approximately 500 feet longer than the Proposed Route. The pipe location would be located 25 feet outside the boundaries of the Zone 1 area.

The northeast alternative will require the securing of a right-of-way 50 feet wide and extensive clearing of trees. The northeast alternative is estimated to cost approximately $1,937,000 per mile or $734,000 for an additional 2000 feet of pipeline. This is approximately $184,000 more than the Proposed Route not including the right-of-way costs.

The alternative to avoid the Well Field to the southwest would be installed in the following residential streets:

- Jacoby Street to Grand Street
- Grand Street South to Niles Street
- Niles Street to Quaker Bridge Road South
- Quaker Bridge Road across the Croton River to Quaker Ridge Road
- Quaker Ridge Road to the ConEd right-of-way

For photo references, see Appendix A (Photos 38-43).

The approximate length of the southwest alternative is 8000 feet versus the Proposed Route of 1500 feet. The cost of the southwest route is estimated to be approximately $4.4 million versus approximately $550,000 for the Proposed Route.

11. Conclusions

The current conditionally approved Millennium route has significant environmental impacts on the sensitive coastal zone resources of Haverstraw Bay, Croton-on-Hudson Well Field, and the Jane E. Lytle Memorial Arboretum. There are alternatives to this route that are technically and environmentally feasible; constructable; avoid the sensitive coastal zone resources of Haverstraw Bay, the Croton-on-Hudson Well Field and the Arboretum; and are significantly less costly than Millennium's proposal.

Millennium's dismissal of directional drilling as a means of reducing the impact to Haverstraw Bay in particular the eastern half was predicated on limited research.